

## Appendix K2

# ***Design Memorandum***

# US 281 EIS

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## **DRAFT** CONCEPTUAL SCHEMATIC (10%) TECHNICAL MEMO CSJ: 0253-04-138

**August 2011**

Prepared For



*Note: This document is released under the authority of Stephanie Messerli, PE 87512, on August 23, 2011 for Alamo RMA review. It is not intended for construction or permitting purposes.*

# **JACOBS**

Jacobs Engineering Group Inc., Firm #2966  
2705 Bee Cave Road, Suite 300  
Austin, Texas 78746  
Phone: 512.314.3100

## TABLE OF CONTENTS

INTRODUCTION	2
DESIGN CRITERIA	2
DRAINAGE/WATER QUALITY	3
CONSTRUCTION PHASING	3
COST ESTIMATES	9

**Appendices:** Available upon request.

Appendix A: Design Criteria Table  
Appendix B: Horizontal Alignment Reports  
Appendix C: Drainage Calculations  
Appendix D: Cost Estimate Detail

## **Introduction**

The US 281 EIS is being prepared for the Alamo Regional Mobility Authority (Alamo RMA) to evaluate improvements to the US 281 roadway from Loop 1604 to Borgfeld Drive. The project limits fall completely within Bexar County.

Existing US 281 is composed of three typical roadway sections within these project limits. A short section on the southern end of the project between Loop 1604 and Sonterra Boulevard is a six-lane freeway section. From Sonterra Boulevard to Stone Oak Parkway, US 281 is primarily a six-lane divided arterial. From Stone Oak Parkway to Borgfeld Drive, US 281 is a four-lane divided arterial with periodic left and right turn lanes.

This memo details the design criteria and other factors evaluated during the 10 percent conceptual plan development to evaluate two potential improvement alternatives. The two alternatives are described as follows.

### *Expressway Alternative (non-tolled, tolled, or managed lanes)*

The Expressway Alternative is a limited access facility with continuous one-way frontage roads along US 281. It consists of three main lanes and two/three frontage road lanes in each direction.

### *Elevated Expressway Alternative (non-tolled, tolled, or managed lanes)*

The Elevated Expressway Alternative is an elevated, limited access roadway with two/three main lanes and two/three frontage road lanes in each direction; existing US 281 lanes would remain in place and function as frontage roads. Along the southern section of the roadway, from Loop 1604 north to Stone Oak Parkway, the elevated main lanes would be built on the outside of the existing US 281 roadway and would transition to the west side of the existing US 281 roadway on the northern section north of Stone Oak Parkway to Borgfeld Drive.

## **Design Criteria**

The *TxDOT Roadway Design Manual* was the primary resource for design criteria and guidance. This resource was supplemented with *AASHTO's Policy of Geometric Design of Highways and Streets* when necessary. The geometric design criteria selected for this project is provided in Appendix A. The horizontal alignment reports for each alternative are provided in Appendix B.

## **Drainage/Water Quality**

The project area is divided into 23 basins to facilitate the drainage and water quality analysis for the two alternatives. These basin areas were determined using the existing creek and culvert crossings along with the proposed vertical profiles for each of the alternatives. Crossings flow from west to east with a few exceptions. For both of the alternatives, the US 281 existing culverts would be extended upstream and downstream depending on the limits of the proposed improvements. No additional culverts are proposed for this phase of the analysis. The total extended lengths are provided in *Appendix D*. The Expressway Alternative requires the replacement of the existing bridges at Mud Creek with four longer bridges. For the Elevated Expressway Alternative, the existing bridges at Mud Creek will remain in place.

Detention and water quality ponds were sized for both of the alternatives. The City of San Antonio requires that proposed storm water runoff not increase from the original conditions. The detention pond sizes for the 100-year storm were determined using the Modified Rational Method. Each basin could have more than one detention pond depending on the culvert location within the basin and the space available for the ponds. The project is located in the Edwards Aquifer recharge zone, thus the Texas Commission on Environmental Quality (TCEQ) requires the reduction of total suspended solids (TSS) load. The water quality ponds were sized for all the alternatives using TCEQ's TSS removal spreadsheet. Each basin will have at least one water quality pond to meet the requirements. The detention and water quality pond locations are shown on the Conceptual Schematic Layouts, and summaries of the calculations are provided in *Appendix C*.

The project includes the floodplains of Mud Creek, two unnamed tributaries to Mud Creek, West Elm Creek, Elm Waterhole Creek, and Cibolo Creek. Mud Creek and the two unnamed tributaries are designated as "Zone A" on the FEMA floodplain map: Bexar County, Texas Flood Insurance Rate Map 48029C0277F dated January 4, 2002. The proposed improvements directly affect Mud Creek both upstream and downstream of US 281. West Elm Creek and Elm Waterhole Creek are both designated as "Zone A" downstream of US 281. The proposed improvements for all the alternatives could impact the 100-year floodplains. West Elm Creek is shown on FIRM 48029C140F dated January 4, 2002, and Elm Waterhole Creek is shown on FIRM 48029C0130F also dated January 4, 2002. Cibolo Creek is designated as a "Zone AE" on FIRM 48029C130F. The existing bridges for Cibolo Creek are remaining in place and no new structures are being proposed at this creek, but the proposed water quality and detention ponds are in the proximity of the creek's 100-year floodplain.

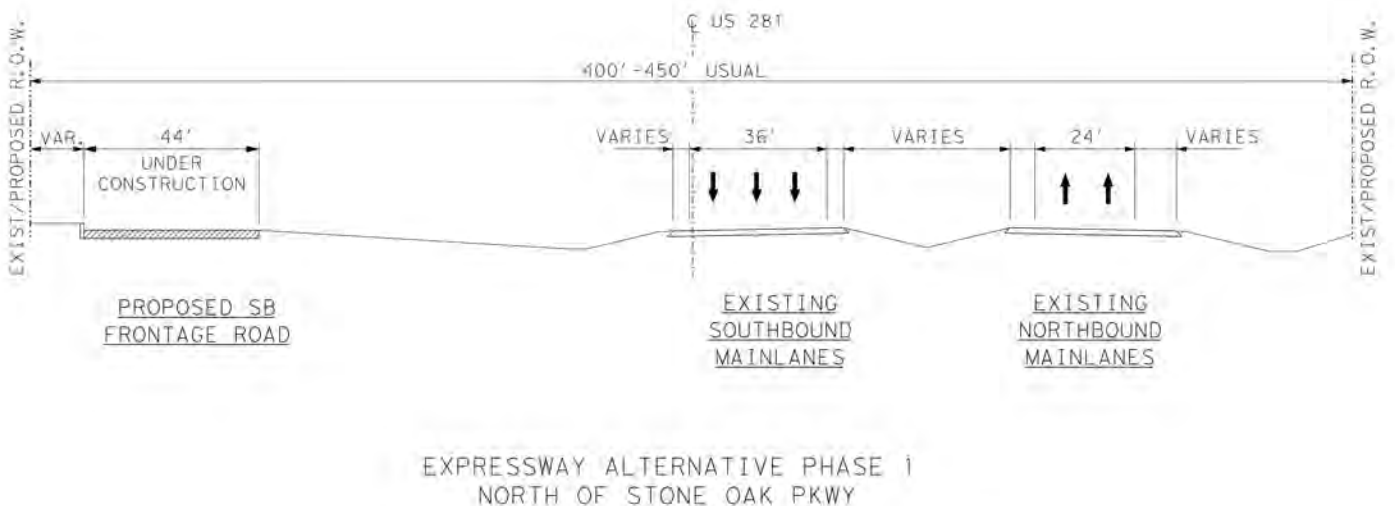
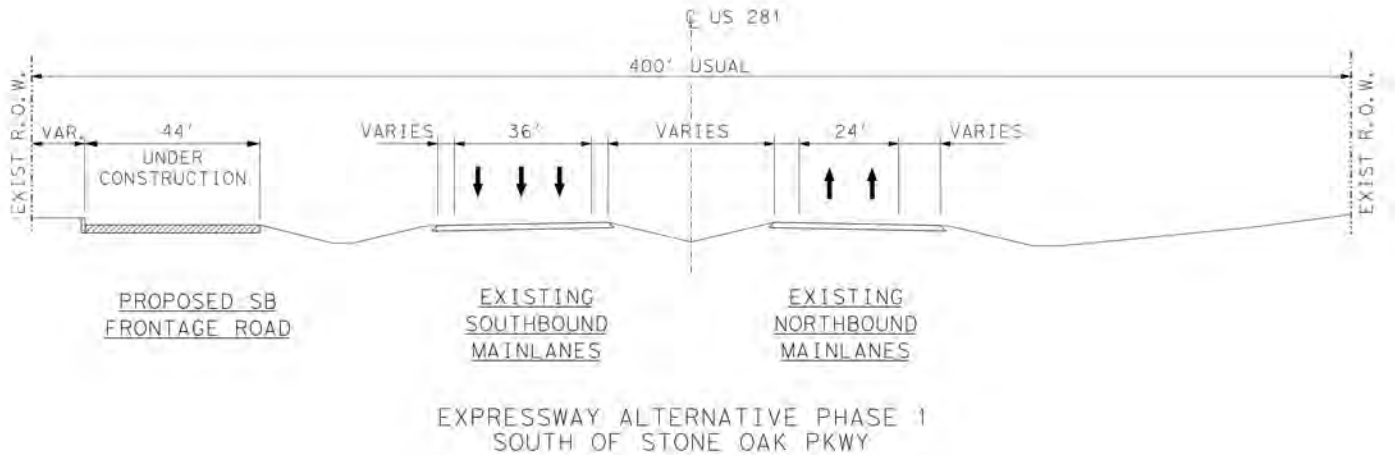
## **Construction Phasing**

Each alternative was evaluated to determine a general phasing of construction. These phasing descriptions are only intended to provide an overview of how traffic would be handled during the construction activities and are developed under the assumption that the entire corridor would be constructed under one construction project. Later phases of design will determine more specific phasing details.

**EXPRESSWAY ALTERNATIVE** – The Expressway Alternative can be constructed by the use of the following three phases of traffic handling.

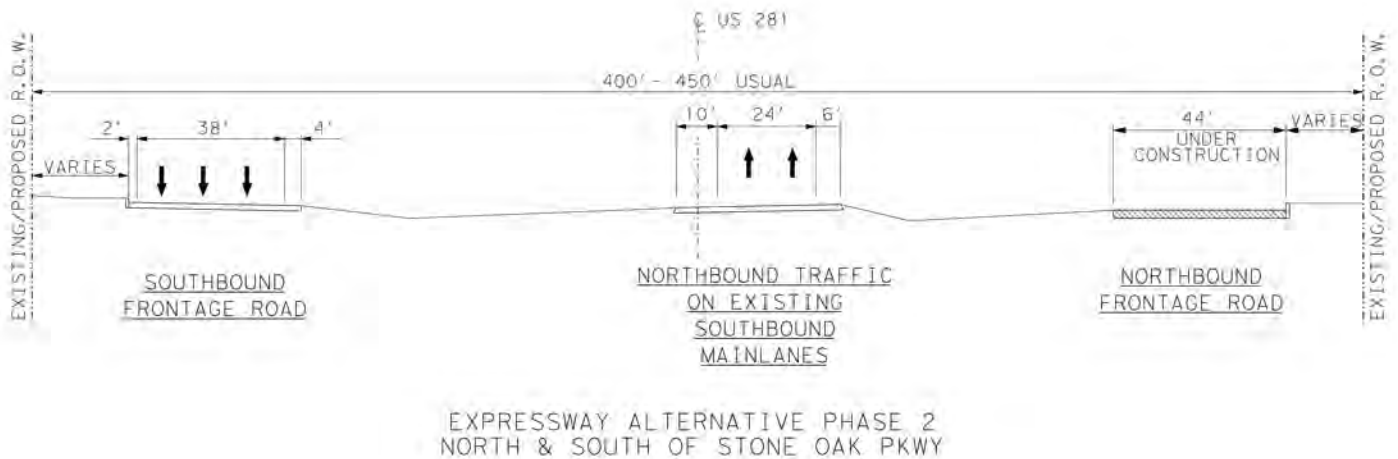
### Phase 1

1. Traffic remains on existing US 281 mainlanes.
2. Construct the proposed southbound frontage roads (SBFR) throughout the length of the project along with any SB ramps that do not interfere with existing US 281 traffic.



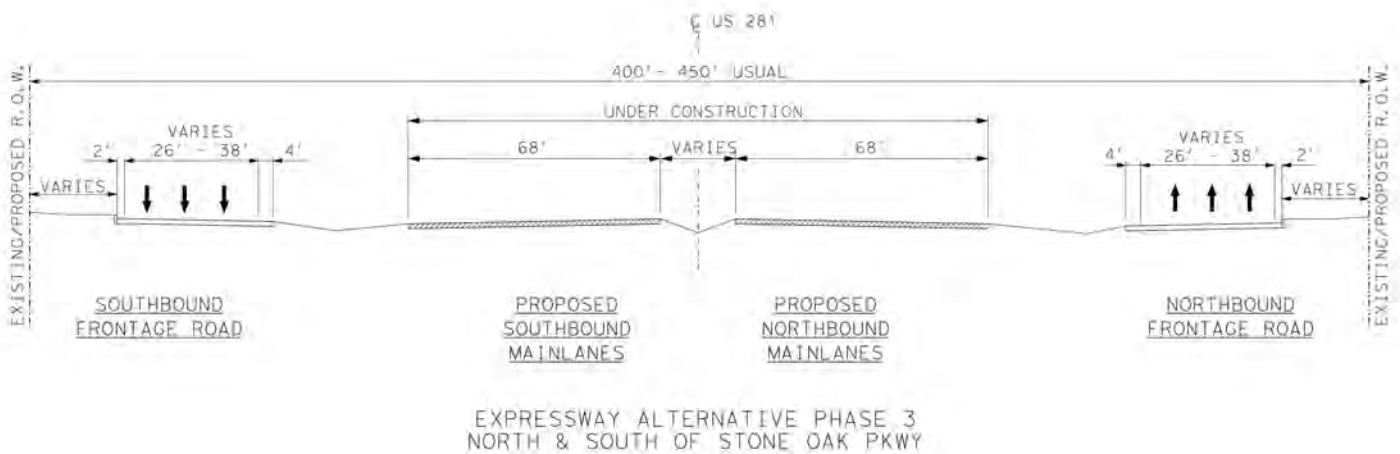
### Phase 2

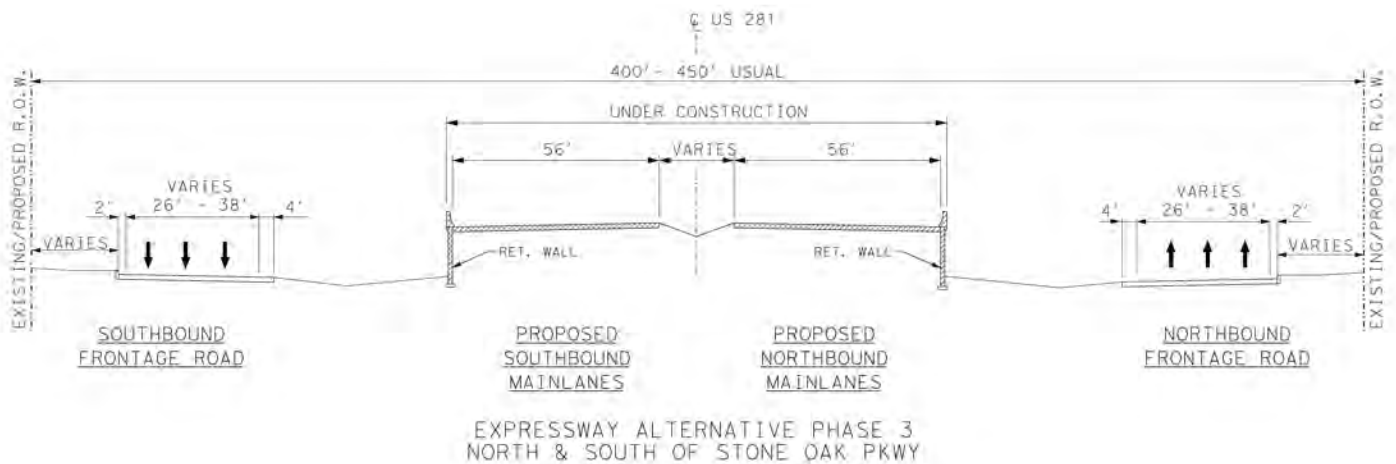
1. Upon completion of the proposed SBFR, place SB traffic onto the SBFR.
2. Place NB traffic onto the existing SB mainlanes (SBML).
3. Construct the proposed NB frontage road (NBFR) and any NB ramps that do not interfere with US 281 traffic.



### Phase 3

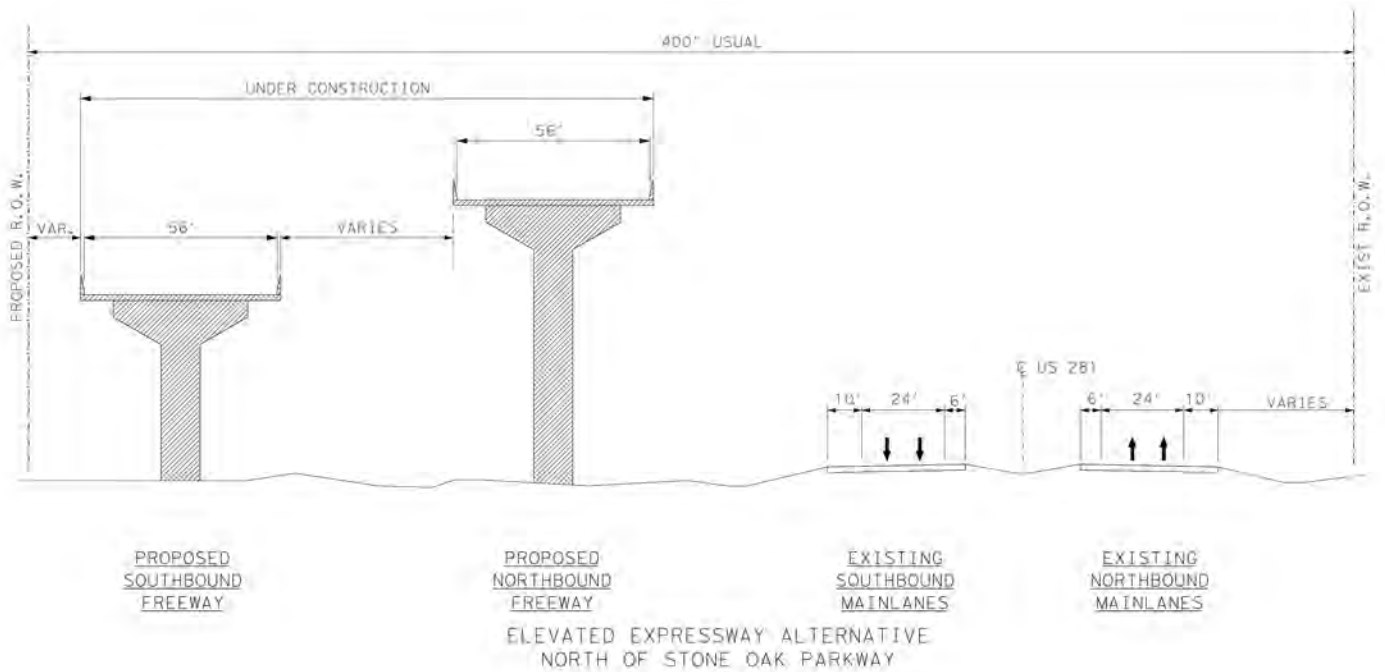
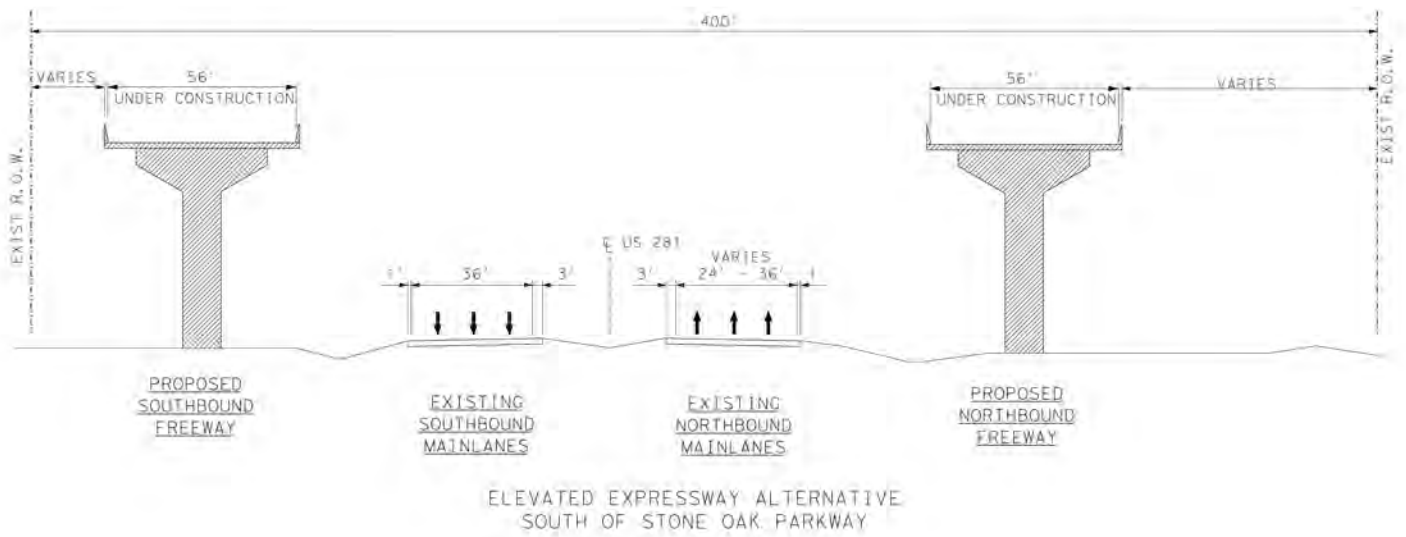
1. Upon completion of the proposed NBFR, place the NB traffic onto the NBFR.
2. With traffic on the frontage roads, construct the proposed NBML & SBML.  
Intersections are to be constructed under traffic and may require lane closures and night work.



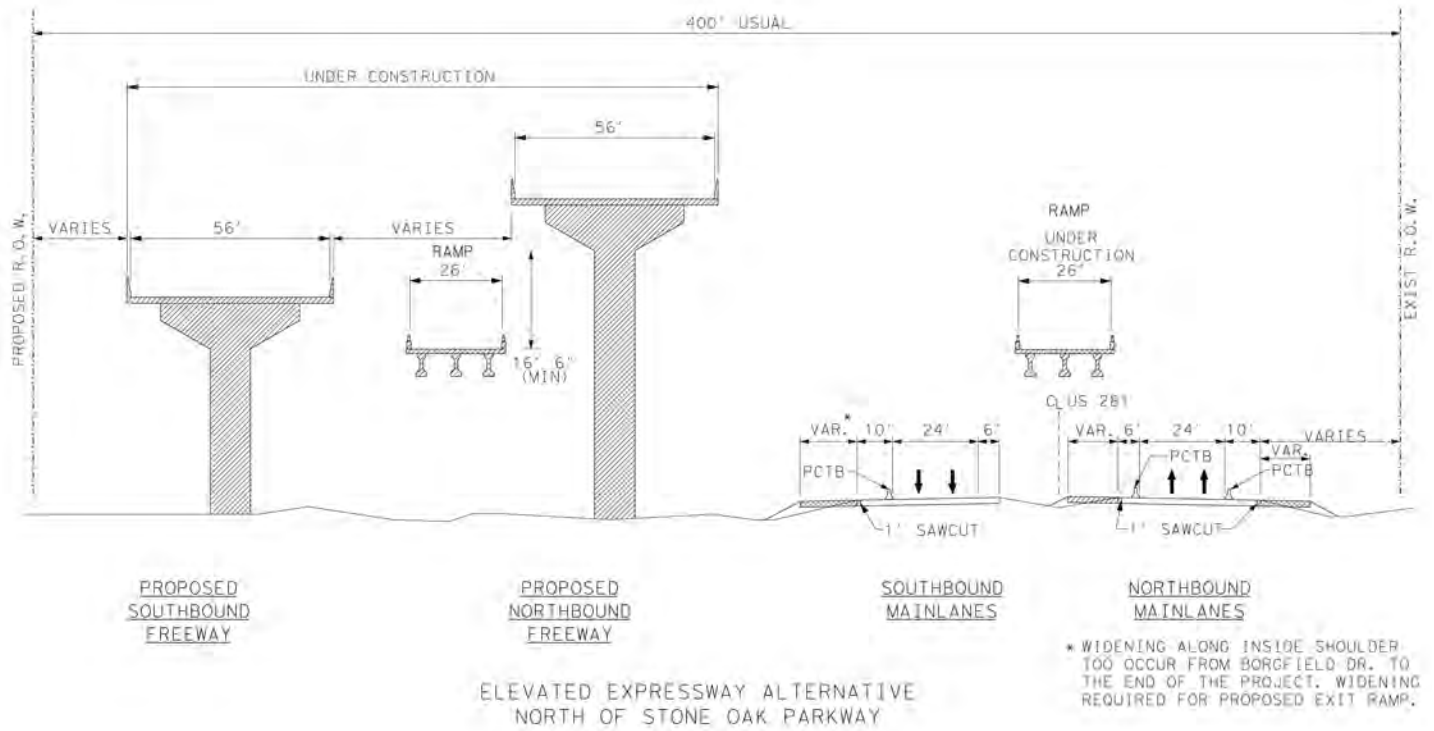


**ELEVATED EXPRESSWAY ALTERNATIVE** – The majority of the Elevated Expressway Alternative construction occurs outside of the existing US 281 pavement and will follow the general steps provided below.

1. Traffic remains on existing US 281 mainlanes.
2. Construct the proposed US 281 mainlanes, access roads, bridge structures and ramps.
3. Place PCTB along outside shoulder of existing US 281 mainlanes and widen the existing pavement to accommodate the proposed entrance and exit ramps which merge into the proposed mainlanes.
4. Place PCTB along the inside shoulder of the existing US 281 NB mainlanes from Borgfeld Dr. to the end of project. Closure of the inside shoulder is necessary to allow for the pavement widening required to accommodate the proposed NB exit ramp.
5. Night work and lane closures will be required to complete all proposed construction (bent construction, beam placement, deck pours, etc) which crosses over or encroaches upon the existing US 281 mainlanes.

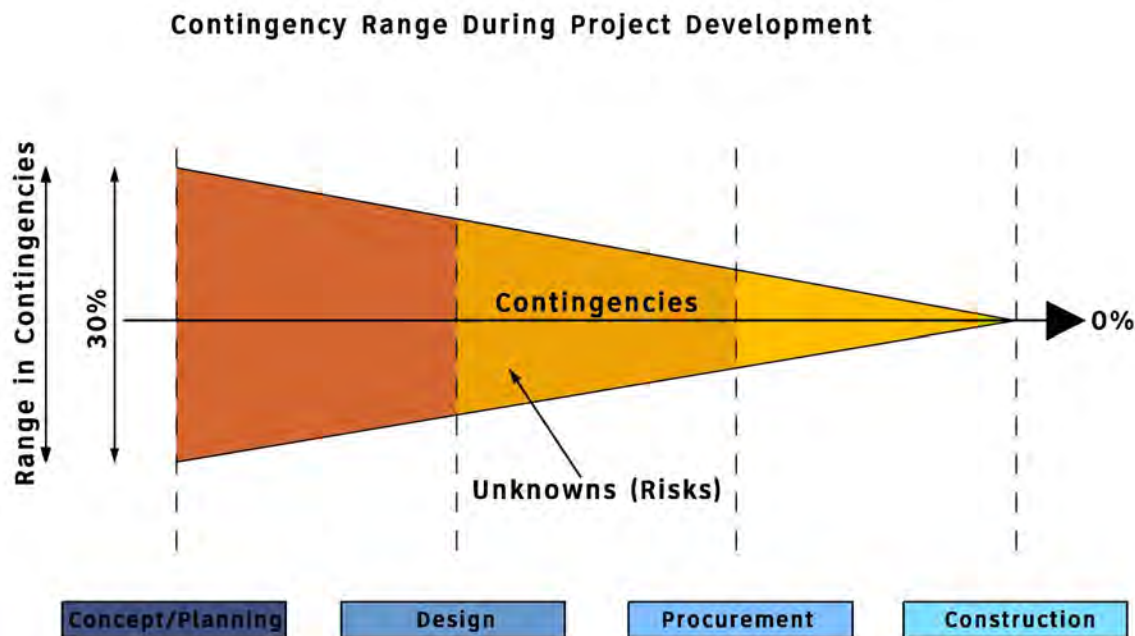


US 281 EIS  
Schematic Technical Memo



## Cost Estimates

See pages 10-12 for a summary of cost items for each alternative. Due to the early design stage of this project, a 30 percent contingency factor was applied to the construction estimate. It is typical at this stage of design to apply a contingency factor to account for project costs that have not yet been identified. As the design is more clearly defined, the contingency factor will decrease and eventually become zero percent as the project moves into construction. The following figure illustrates the typical evolution of contingencies for a project.



For a detailed summary of the quantity and unit costs developed, see Appendix D. Costs were based on 2010-2011 bid history data. The right of way costs were estimated based on a percentage of the land that would need to be acquired and whether the existing improvement(s) would need to be purchased. The parcel values came from the Bexar County 2010 appraisal district.

The cost for each alternative is as follows:

Alternative	Total Engineering, Construction & ROW Cost	Tolling/Managed Lanes Cost	Total Cost with Tolling/Managed Lanes
Expressway	\$433,985,133	\$14,000,000**	\$447,985,133
Elevated Expressway	\$646,184,035	\$9,000,000**	\$655,184,035

\*\*These costs include a five percent mobilization fee as well as equipment costs and installation. Within the professional services, there are allowances for design, testing, project management, and software license fees. The equipment costs include gantries, video cameras, lighting, UPS and backup generator, equipment housing, toll related signage, MOMS, communication systems, AVC system, a pavement tolling apron (including markings, lane controls etc) and the foundations and geotechnical design of the gantries. The Expressway Alternative cost is based on four assumed tolling locations and the Elevated Expressway Alternative cost is based on three assumed tolling locations.

US 281 EIS  
Schematic Technical Memo

EXPRESSWAY ALTERNATIVE				
ITEM	UNIT	UNIT COST	UNIT AMOUNT	COST
Prep ROW Costs	STA	\$ 2,300	385	\$ 885,500
Earthwork				
Unclassified Excavation	CY	\$ 5	1,197,008	\$5,985,040
Unclassified Embankment	CY	\$ 3	2,297,302	\$ 6,891,906
Earthwork Sub-total:				\$ 12,876,946
Pavement				
Mainlane (2 Ln)	LF	\$ 355	2,773	\$ 983,750
Mainlane (3 Ln)	LF	\$ 448	51,694	\$ 23,149,044
Mainlane (4 Ln)	LF	\$ 541	18,228	\$ 9,858,758
Mainlane (5 Ln)	LF	\$ 634	1,359	\$ 861,479
Frontage Road (2 Ln)	LF	\$ 272	41,541	\$ 11,294,647
Frontage Road (3 Ln)	LF	\$ 365	26,049	\$ 9,506,331
Frontage Road (4 Ln)	LF	\$ 458	4,350	\$ 1,992,253
Frontage Road (5 Ln)	LF	\$ 551	3,251	\$ 1,791,424
Turnaround (20' Width)	LF	\$ 220	6,365	\$ 1,400,549
Ramp (1 Ln)	LF	\$ 184	33,158	\$ 6,106,778
Ramp (2 Ln)	LF	\$ 308	1,609	\$ 495,952
Driveways	LSUM	\$ 637,484	1	\$ 637,484
Crossing Roadway				
Redland (between FRs)	LF	\$ 282	486	\$ 137,087
Redland (outside of FRs)	LF	\$ 344	118	\$ 40,604
Encino (between FRs)	LF	\$ 502	294	\$ 147,621
Encino (outside of FRs)	LF	\$ 642	272	\$ 174,538
Evans	LF	\$ 688	710	\$ 488,628
Stone Oak	LF	\$ 502	670	\$ 336,414
Marshall (between FRs)	LF	\$ 437	328	\$ 143,386
Marshall (outside of FRs)	LF	\$ 344	500	\$ 172,052
Wilderness	LF	\$ 468	507	\$ 237,362
Overlook	LF	\$ 502	707	\$ 354,992
Bulverde (between FRs)	LF	\$ 468	319	\$ 149,346
Bulverde (outside of FRs)	LF	\$ 324	819	\$ 265,146
Borgfeld (between FRs)	LF	\$ 533	305	\$ 162,604
Borgfeld (outside of FRs)	LF	\$ 324	921	\$ 298,168
Pavement Sub-total:				\$ 71,186,395
Retaining Walls				
Retaining Wall (MSE)	SF	\$ 35	595,593	\$ 20,845,755
Retaining Wall (Tieback)	SF	\$ 80	128,425	\$ 10,274,000
Retaining Wall Sub-total:				\$ 31,119,755
Bridges				
Overpass	SF	\$ 50	521,228	\$ 26,061,400
Direct Connector	SF	\$ 70	382,806	\$ 26,796,420
Bridge Sub-total:				\$ 52,857,820
Traffic Signals	EA	\$ 150,000	9	\$ 1,350,000
Traffic Control (Barricades)	MO	\$ 25,000	36	\$ 900,000
Project Sub-total:				\$ 171,176,416
Drainage Structures	LSUM	\$ 29,034,912	1	\$ 29,034,912
Signing, Striping, Delineation (2%)	LSUM	\$ 3,423,528	1	\$ 3,423,528
Illumination (10%)	LSUM	\$ 17,117,642	1	\$ 17,117,642
Pedestrian & Context Sensitive Solutions (10%)	LSUM	\$ 17,117,642	1	\$ 17,117,642
SW3P (2%)	LSUM	\$ 3,423,528	1	\$ 3,423,528
TCP (3%)	LSUM	\$ 5,135,292	1	\$ 5,135,292
Utilities (10%)	LSUM	\$ 17,117,642	1	\$ 17,117,642
SUB-TOTAL:				\$ 263,546,602
30% Contingency				\$ 79,063,981
10% Mobilization				\$ 34,261,058
TOTAL:				\$ 376,871,641
7% Engineering:				\$ 26,381,015
RIGHT OF WAY:				\$ 30,732,477
GRAND TOTAL:				\$ 433,985,133

<b>ELEVATED EXPRESSWAY ALTERNATIVE</b>				
<b>ITEM</b>	<b>UNIT</b>	<b>UNIT COST</b>	<b>UNIT AMOUNT</b>	<b>COST</b>
<b>Prep ROW Costs</b>	STA	\$ 2,300	385	\$ <b>885,500</b>
<b>Earthwork</b>				
Unclassified Excavation	CY	\$ 5	194,374	\$ 971,870
Unclassified Embankment	CY	\$ 3	91,264	\$ 273,792
<b>Earthwork Sub-total:</b>				\$ <b>1,245,662</b>
<b>Pavement</b>				
Ramp (1 Ln)	LF	\$ 204	11,767	\$ 2,399,653
Ramp (2 Ln)	LF	\$ 277	2,179	\$ 604,086
Mainlane (2 Ln)	LF	\$ 339	1,008	\$ 341,966
Mainlane (3 Ln)	LF	\$ 510	505	\$ 257,470
Mainlane (Widening)	LF	\$ 123	16,483	\$ 2,029,085
Access Road (Residential)	LF	\$ 98	2,032	\$ 199,194
Access Road (Residential with C&G)	LF	\$ 137	2,426	\$ 331,337
Access Road (Commercial)	LF	\$ 145	12,142	\$ 1,765,847
<b>Pavement Sub-total:</b>				\$ <b>7,928,639</b>
<b>Retaining Walls</b>				
Retaining Wall (MSE)	SF	\$ 35	143,731	\$ 5,030,582
Retaining Wall (Tieback)	SF	\$ 80	1,750	\$ 140,000
<b>Retaining Wall Sub-total:</b>				\$ <b>5,170,582</b>
<b>Bridges</b>				
Mainlane	SF	\$ 65	3,759,472	\$ 244,365,680
Ramp	SF	\$ 65	402,558	\$ 26,166,270
Direct Connector	SF	\$ 70	137,844	\$ 9,649,080
<b>Bridge Sub-total:</b>				\$ <b>280,181,030</b>
<b>Traffic Signals</b>	EA	\$ 150,000	4	\$ <b>600,000</b>
<b>Traffic Control (Barricades)</b>	MO	\$ 15,000	48	\$ <b>720,000</b>
<b>Project Sub-total:</b>				\$ <b>296,731,413</b>
<b>Drainage Structures</b>	LSUM	\$ 21,207,999	1	\$ <b>21,207,999</b>
<b>Signing, Striping, Delineation (1%)</b>	LSUM	\$ 2,967,314	1	\$ <b>2,967,314</b>
<b>Illumination (10%)</b>	LSUM	\$ 29,673,141	1	\$ <b>29,673,141</b>
<b>Pedestrian &amp; Context Sensitive Solutions ( 10%)</b>	LSUM	\$ 29,673,141	1	\$ <b>29,673,141</b>
<b>SW3P (1%)</b>	LSUM	\$ 2,967,314	1	\$ <b>2,967,314</b>
<b>TCP</b>	LSUM	\$ 3,500,000	1	\$ <b>3,500,000</b>
<b>Utilities</b>	LSUM	\$ 20,000,000	1	\$ <b>20,000,000</b>
<b>SUB-TOTAL:</b>				\$ <b>406,720,322</b>
30% Contingency				\$ 122,016,097
10% Mobilization				\$ 52,873,642
<b>TOAL:</b>				\$ <b>581,610,061</b>
<b>7% Engineering:</b>				\$ 40,712,704
<b>RIGHT OF WAY COST:</b>				\$ 23,861,270
<b>GRAND TOTAL:</b>				\$ <b>646,184,035</b>

## Elevated Expressway Alternative Storm Sewer Summary

ALTERNATIVE	400 2003	402 2001	432 2066	464 2003	464 2005	464 2007	464 2009	464 2010	464 2011	464 2022	464 2024	464 2026	464 2027
	STRUCT EXCAV (PIPE)	TRENCH EXCAVATION PROTECTION	RIP RAP (CONC) (CL B)	RC PIPE (CL III) (18 IN)	RC PIPE (CL III) (24 IN)	RC PIPE (CL III) (30 IN)	RC PIPE (CL III) (36 IN)	RC PIPE (CL III) (42 IN)	RC PIPE (CL III) (48 IN)	RC PIPE (CL IV) (24 IN)	RC PIPE (CL IV) (30 IN)	RC PIPE (CL IV) (36 IN)	RC PIPE (CL IV) (42 IN)
	CY	LF	CY	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
ELEVATED EXPRESSWAY	23270	19217	1523	25758	10422	6902	1962	4080	1022	1564	1040	295	612

Unit Price	\$3.00	\$2.00	\$275.00	\$30.00	\$40.00	\$50.00	\$65.00	\$85.00	\$100.00	\$50.00	\$70.00	\$115.00	\$140.00
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TOTAL COST	\$69,808.50	\$38,434.50	\$418,893.75	\$772,726.50	\$416,898.00	\$345,123.93	\$127,500.75	\$346,774.50	\$102,150.00	\$78,187.50	\$72,765.00	\$33,896.25	\$85,680.00
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The Elevated Expressway Alternative is estimated to be 45% of the cost of the Expressway Alternative.

ALTERNATIVE	464 2028	465 2001	465 2007	465 2006	465 2014	465 2081	465 2092	465 2188	465 2203	465 2211	465 2253
	RC PIPE (CL IV)(48 IN)	INLET (COMPL)(TY C)	INLET EXT (TY C)	MANH (COMPL) (JUNCT BOX) (TY M)	MANH (COMPL) (JUNCT BOX)	INLET (COMPL)(GRATE) (TY 1)	MANH (COMPL)(TY 1)	INLET (COMPL)(DROP ) (TY Y-1)	INLET (COMPL)(CTB) (TY S)	JUNCTION BOX (SPL)	INLET (COMPL)(CTB) (TY M)
	LF	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA
ELEVATED EXPRESSWAY	153	8	8	57	5	9	32	85	8	20	65

Unit Price	\$140.00	\$3,500.00	\$1,500.00	\$4,100.00	\$4,000.00	\$3,000.00	\$3,200.00	\$4,600.00	\$7,000.00	\$9,000.00	\$6,000.00
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TOTAL COST	\$21,420.00	\$28,350.00	\$12,150.00	\$232,470.00	\$18,000.00	\$27,000.00	\$103,680.00	\$389,160.00	\$56,700.00	\$182,250.00	\$388,800.00
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The Elevated Expressway Alternative is estimated to be 45% of the cost of the Expressway Alternative.

## Elevated Expressway Alternative Cross Culvert Summary

### ELEVATED EXPRESSWAY ALT CROSS CULVERTS

	0462 2002 CONC BOX CULV (3 FT X 3 FT) LF	0462 2004 CONC BOX CULV (4 FT X 3 FT) LF	0462 2010 CONC BOX CULV (6 FT X 3 FT) LF	0464 2024 RC PIPE (CL IV) (30 IN) LF	466 2020 WINGWALL (FW-0) (HW=4 FT) EA	466 2034 WINGWALL (FW-S) (HW=4 FT) EA	468 2067 HEADWALL (CH-FW-0) (DIA= 30 IN) EA
A							
B							
C							
D							
E	25				1		
F	30					1	
G							
H							
I			135			1	
J							
K							
L							
M							
N	262				1	1	
O							
P							
Q							
R	32					1	
S							
T		66			1	1	
U							
V							
W				49			1
TOTAL	349	66	135	49	3	5	1

Unit Price	\$100	\$120	\$180	\$70	\$4,050	\$8,000	\$3,500
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TOTAL COST	\$34,900	\$7,920	\$24,300	\$3,430	\$12,150	\$40,000	\$3,500
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## Elevated Expressway Alternative Detention and Water Quality Pond Summary

ELEVATED EXPRESSWAY ALT PONDS		
	DETENTION POND CF	WATER QUALITY POND CF
AA	12,333	6,356
A	21,082	6,215
B	20,698	151,793
C	14,884	4,096
D	40,194	20,804
E	16,681	11,184
F	34,098	15,998
G	69,225	29,020
H	37,142	14,967
I	121,236	69,165
J	29,946	17,973
K	12,550	3,405
L	16,795	6,465
M	72,720	37,822
N	42,825	19,533
O	31,978	10,204
OO	178,150	81,314
P	34,587	14,157
Q	73,860	35,829
R	30,176	10,189
S	23,776	3,646
T	14,845	3,164
U	56,985	27,734
V	20,891	5,652
W	29,257	7,700
<b>TOTAL</b>	<b>1,056,913</b>	<b>614,385</b>

<b>Unit Price</b>	<b>\$10</b>	<b>\$10</b>
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<b>TOTAL COST</b>	<b>\$10,569,134</b>	<b>\$6,143,845</b>
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